Advanced Information Systems Technology

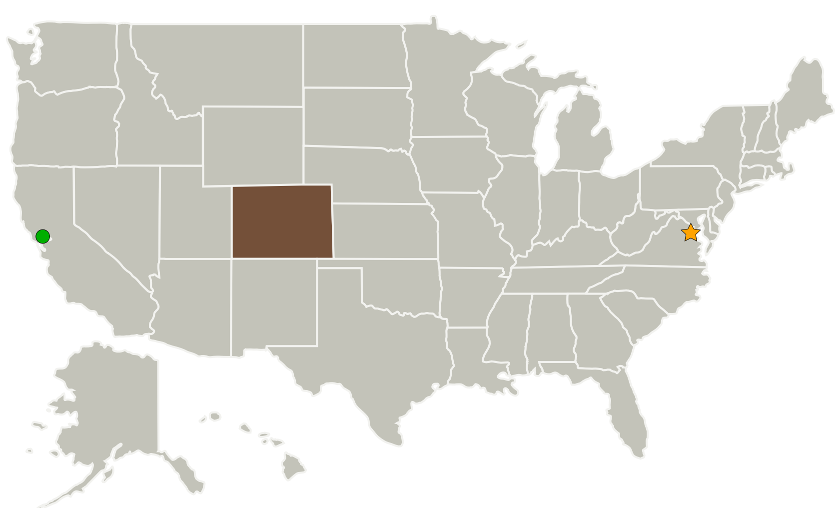
Model Predictive Control Architecture for Optimizing Earth Science Data Collection

Completed Technology Project (2015 - 2017)

Project Introduction

The increasing importance of distributed space-based sensor systems has led to exciting developments in large-scale data extraction software and synthesis of complex data products. In particular, this has pushed the development of sensor web software to coordinate the data collection process. What is not well-developed is the local (or flight) software for fast control of systems with many degrees of freedom. Two examples of such systems are the newly developed Electronically Steerable Flash Lidar (ESFL), and tight formation flying control of future Cubesat missions. We propose a local, multi-layered control system architecture which communicates with the higher level software layers. The local control is based upon an architecture known as Model Predictive Control (MPC). MPC has found use in many different complex systems where the controlled system is characterized as multivariable, with multiple constraints and possibly nonlinear. These include robotic vision systems, chemical processing and has been proposed for quad-rotor and formation flying spacecraft. MPC optimizes the data collection at each time step from higher level constraints and commands and is enabled by the increased computational power now available in FPGA implementations. We propose to develop the MPC architecture for ESFL and use models to verify it's capability from synthetic scenes and fusion with other sensors. ESFL has potentially hundreds of individually steerable laser beamlets and when combined with other sensor poses a large optimization problem well suited to the MPC approach. The technology developed under this effort is applicable to formation flying systems also.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Center / Facility:

NASA Headquarters (HQ)

Responsible Program:

Advanced Information Systems Technology

Organizations Performing Work	Role	Type	Location
NASA Headquarters(HQ)	Lead Organization	NASA Center	Washington, District of Columbia
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Ball Aerospace & Technologies Corporation	Supporting Organization	Industry	Boulder, Colorado

Primary U.S. Work Locations
Colorado

Project Management

Program Director:

Pamela S Millar

Program Manager:

Jacqueline J Le Moigne

Principal Investigator:

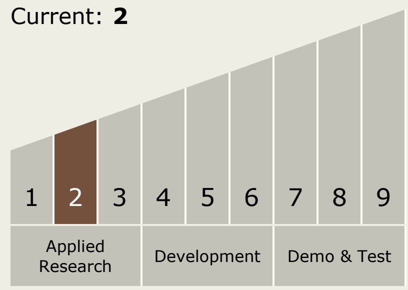
Mike D Lieber

Co-Investigators:

Reuben R Rohrschnelder
Jennifer Sheehan
Lyle Ruppert

Technology Maturity (TRL)

Start: **2**
Current: **2**



Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  └ TX11.1 Software Development, Engineering, and Integrity

Continued on following page.

Technology Areas *(cont.)*

- └ TX11.1.7 Frameworks, Languages, Tools, and Standards

Target Destination

Earth